Practical Physiotherapy for Small Animal Practice
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David Prydie
Isobel Hewitt
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About the authors

DAVID PRYDIE
BVMS, CertSAO, CCRT, MRCVS

David Prydie with his two terrier crosses Spud and Sprout, and his Pomeranian, Mr. Darcy.

David graduated from Glasgow veterinary school in 1981 and obtained his certificate in Small Animal Orthopaedics in 1991. He has worked in first opinion and orthopaedic referral practice throughout the United Kingdom. In 2009, David obtained his Certificate in Canine Rehabilitation from The Canine Rehabilitation Institute, USA. He currently owns and runs Physio-Vet, a dedicated small animal physiotherapy practice in Cheshire, Crewe, UK (www.physio-vet.co.uk). David has lectured on animal rehabilitation and physiotherapy at many national and international conferences. His particular interests are canine sports medicine and the management of chronic musculoskeletal diseases, such as canine osteoarthritis and degenerative myelopathies.
Isobel Hewitt
BSc (Hons.) MSc, ACPAT (Cat A)

Isobel Hewitt with her Staffordshire Bull Terrier Wilson and her Staffy Cross Marley.

Isobel graduated in physiotherapy in 2003 from Sheffield Hallam University. She is a Chartered Physiotherapist and has many years of experience as a human physiotherapist. She has her own human physiotherapy practice specialising in musculoskeletal physiotherapy. In 2009, she completed her MSc in Animal Physiotherapy from the Royal Veterinary College, London. She has worked at Physio-Vet since its opening. Her special interests are proprioceptive retraining, orthotic and splinting devices and functional rehabilitation for small animals.

She is a category A member of ACPAT (Association of Chartered Physiotherapists in Animal Therapy).
Physiotherapy on dogs and cats has been practiced for well over 25 years. The benefits for patients and practices have been clearly demonstrated. This said, there is still little undergraduate training and the majority of practices offer little or no physiotherapy. A lot of people within the profession are aware of physiotherapy but are not quite sure what it involves.

This textbook is aimed at veterinary surgeons, veterinary nurses and others who want to know more about physiotherapy in small animals. These people may be considering introducing physiotherapy to their practice or considering a training course. We have tried to explain what physiotherapy is and how it is of benefit to the animal, owner and practice. For those who want more details and evidence of the benefits of physiotherapy in small animals, please refer to the Further Readings section (Appendix 3).

We have written this textbook from a practical point of view with advice on selection of equipment, examination, treatment protocols and charging. Our writings and recommendations are based on the cases that we see and treat on a daily basis. We have included chapters on healing and anatomy as they form the basis of treatment protocols and examination. The textbook is by no means definitive and it is important for each therapist to develop his/her own examination and treatment protocols. However, this can only be done with experience of cases. This textbook offers a starting place that can then be adapted and built upon.

David Prydie
Isobel Hewitt
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David Prydie would like to dedicate this textbook to the memory of his parents. His father, Jack, was also a veterinary surgeon and one of the pioneers in the development of small animal vaccines, died in 1988. David’s mother, Nan, died in the last week of writing this textbook.
Practical Physiotherapy for Small Animal Practice is accompanied by a companion website:

www.wiley.com/go/practical-physiotherapy-for-small-animals

The website includes:

- Client education handouts.
CHAPTER 1

Introduction

All professions develop and evolve as new research is conducted; pioneering techniques become everyday techniques and in veterinary medicine, the use of physiotherapy to complement current treatments is becoming more widely recognised and utilised. Many owners are becoming more aware of physiotherapy through magazines, dog training clubs, social media and word of mouth that often they seek out physiotherapists and are asking whether it could be beneficial for their pets. Physiotherapy must always be carried out after a veterinary consultation and with veterinary consent. It is important to seek out appropriately qualified practitioners to carry out physiotherapy in order to ensure that no harm will come to animals during treatment. This textbook aims to introduce physiotherapy, discussing and outlining its basic principles.

Physiotherapy is defined as the therapeutic use of physical agents or means, such as massage or exercises, to treat disease or injury. It is an extremely useful adjunct to medicine, human and veterinary. The aim is to restore mobility/function and quality of life to patients. This is done by stimulating the healing process to restore injured tissues, improve the balance/strength of the injured tissues and stabilising the cardiorespiratory, neurological and musculoskeletal systems. Physiotherapy also has an important role in optimising performance and injury prevention in sporting and working animals. It can be performed on any animal, but the majority of cases seen in small animal practice are dogs.

Physiotherapy is often used to correct complications that may have occurred as a result of surgery; however, if introduced early and appropriately, these complications can be avoided. The rehabilitation must be of the highest standard to fulfill the expectations of owners and veterinarians alike. For example, following TTA surgery, physiotherapy will aid correct gait re-education—whereas without physiotherapy, the animal may adopt an adaptive gait pattern.

Physiotherapy can be beneficial for animals in a wide range of conditions. Traditionally, physiotherapy is divided into a wide variety of specialties. In veterinary medicine, we could see the following divisions:

- Musculoskeletal.
- Respiratory.
- Orthopaedics.
- Neurological.
- Sports medicine.
• Elderly care/geriatrics.
• Developmental problems.

Musculoskeletal: Most people consider this as ‘traditional physiotherapy’. The conditions seen can be split into soft-tissue injuries, such as sprains/strains or ruptures of ligament, tendon or muscle; bursitis and bone or joint injuries, such as fractures (Figure 1.1) or joint disease, such as OCD. The injuries may be a result of either a traumatic event or overuse, where the owner cannot recall the specific onset of symptoms.

Respiratory: This is the acute care of animals in hospital; it could be post-anaesthetic recovery or ventilated animals. Physiotherapy is aimed to manage secretions, prevent pressure sores, prevent atelectasis, reduce the work of breathing and optimise the ventilation/perfusion ratio to ensure high oxygen saturation levels. These aims are achieved using positioning (for pressure relief, postural drainage or to influence ventilation/perfusion ratio within the lungs), manual techniques such as percussion (Figure 1.2) or vibrations to remove secretions, neuromuscular techniques such as rib springing to increase lung capacity and manual hyperinflation or bagging to improve ventilation and aid secretion removal.

Orthopaedics: Physiotherapy following surgery is used to maximise the success of surgery. By working with the surgeon, the recovery can be optimised. Orthopaedic surgeons may have their own protocols for rehabilitation following surgery and knowledge of these protocols is needed by the owner and therapist before embarking on a rehabilitation programme. These protocols guide the therapist on how much weight can be put through the leg and when different exercises can be introduced.

Figure 1.1  Post fracture. This picture shows an Alaskan Malamute following a femoral fracture after being kicked by a horse. The main aims of physiotherapy for this dog are to improve its weight bearing on the leg and increase its muscle mass/strength.
Respiratory physiotherapy: Following anaesthesia any animals requiring ventilation have the potential to develop retained secretions. Ventilated animals will also be sedated and therefore not move around, which can cause secretions to pool in the lungs and need removal.

Neurological: Neurological physiotherapy is the rehabilitation of the animal following neurological injury, which can involve single limb or whole body. Neurological damage can be managed conservatively or surgically and may completely resolve or can leave lasting damage. The amount of initial damage usually has a significant impact on the amount of recovery that can be achieved. Long-term solutions to permanent damage sometimes have to be sought, such as wheels, harnesses or splints, to support the animal’s everyday activities (Figure 1.3).

Sports medicine: The preparation of an animal for athletic activity is extremely important requiring physical training, skill training and cardiovascular training. Physiotherapy can help guide owners on appropriate conditioning programmes for certain sports and specific to the animal being trained. Different sports will place very different demands on a dog, for example, the endurance capability of a sled dog opposed to the speed of a racing greyhound.

The rehabilitation of sports injuries is also extremely important as often these animals are not lame but subtle changes in muscle tightness can affect their performance.

Elderly care/geriatics: As pets (and owners) are living longer now, there is a high population of arthritic animals seen in clinics; they can often have other

Neurological physiotherapy: After a neurological event, physiotherapy can aid recovery by providing sensory input and re-education of normal movement.

Figure 1.2  Respiratory physiotherapy. Following anaesthesia any animals requiring ventilation have the potential to develop retained secretions. Ventilated animals will also be sedated and therefore not move around, which can cause secretions to pool in the lungs and need removal.

Figure 1.3  Neurological physiotherapy. After a neurological event, physiotherapy can aid recovery by providing sensory input and re-education of normal movement.
co-morbidities such as diabetes that can complicate the rehabilitation process. The provision of a holistic approach to managing these animals, using tools such as Aim OA (http://aimoasys.com/why-aim-oa/) will mean they can stay comfortable and functional for longer. The AIM OA website is available for veterinary practices to help provide holistic care for the elderly and arthritic animals. It uses a management strategy encompassing pain relief, exercises, diet and environmental factors.

*Developmental problems:* A large number of young animals are seen with genetic/developmental problems, and they benefit greatly from physiotherapy to support their joints. Conditions such as hip and elbow dysplasia are often seen. Physiotherapy can improve their quality of life and prevent further problems or surgeries such as total hip replacements.

**The benefits of physiotherapy**

Physiotherapy can be of benefit to all animals; however, the choice of treatment can be limited by any concurrent disease or illness. The behaviour of an animal, the level of understanding of the owner and their emotions can all influence the success of physiotherapy. For example, a nervous owner will unsettle the animal causing it to become tense which can adversely affect the examination and subsequent treatment session. The objective of physiotherapy is for the animal and the owner to be part of the treatment and it therefore must be as least stressful experience for both of them as possible.

The objectives of a rehabilitation programme are to reduce pain, restore movement, improve gait, increase muscle strength and improve function. From these broad objectives, the formation of a rehabilitation programme will be tailored to suit an individual’s situation and take into account the many factors that influence rehabilitation.

The knowledge of the healing process (which is outlined in Chapter 3) can help maximise strength of healing tissues following injury and prevent complications arising from the healing process. This is achieved by giving appropriate physiotherapeutic intervention at an appropriate time.

The examination (which is outlined in Chapter 4) of an animal will help identify not only the injury that it has been referred to physiotherapy for, but also any compensations that have occurred as a result of that injury. The physiotherapist will also assess the animal’s conformation and posture as this is the cornerstone for good movement. A poor conformation can tighten muscles, and chronically tight muscles can alter bone alignment, which in turn can complicate rehabilitation. Understanding movement, posture and conformation means the animal will be treated holistically and this can improve the long-term prognosis for an animal (Figures 1.4 and 1.5).

When treating animals, it is also very important to educate the owners on how they can help the rehabilitation process, through a home exercise programme and self-management strategies. It is important to understand the clients’ expectations of physiotherapy and their goals/aims for the animal. The introduction of physiotherapy at the appropriate time will often promote the safe return to function or activity at the earliest time.
In elderly patients or those with a chronic problem, an ongoing physiotherapy programme will maintain the function of an animal for as long as possible. It is particularly useful in these cases to educate the owner on adaptations that can be made in the home environment to support their animal, such as the provision of rugs on slippery floors and placing the animal’s bed out of drafts to ensure they do not get cold and stiffen up overnight (in arthritic animals).

Physiotherapists are trained to conduct specific and progressive rehabilitation programmes based on evidence-based treatments. By setting goals throughout the treatment process, the owner (and therapist) can monitor the progress of the animal towards the completion of treatment.

Physiotherapy is used to maintain soundness in competition animals by training owners to be able to recognise signs of reduced performance and educating them on warm ups or stretches for their animals. The provision of competition-specific conditioning programmes for athletic dogs and preseason checks will help to prevent injury. These checks will help to identify any areas of the dog that show subtle changes.

Figure 1.4  Poor conformation. This shows poor conformation where the angle of the joints is not ideal leading to muscle imbalance that can cause dysfunction and pain.

Figure 1.5  Good conformation. An animal with good conformation is less likely to have injuries and develop problems as its muscular and skeletal systems are in balance.
in range of movement that could be caused by trigger points in the muscle, which, if treated, will not cause loss of performance.

**Contraindications**

There are numerous contraindications to specific physiotherapeutic techniques and they are addressed individually within the relevant chapters. There are certain conditions where caution should be taken, these include:

*Pregnancy* – Manual therapies and certain electrotherapies are contraindicated due to the increased mobility around joints during pregnancy and the affect of electrotherapy on growing tissues. It is also worth noting that pregnancy of the owner needs to be known if using pulsed electromagnetic energy.

*Cancer* – If the patient has known metastatic disease, electrotherapy is contraindicated in that area and is questionable whether it should be used at all. The patient is also likely to fatigue easily, and hence exercise therapy needs to be kept gentle.

*Circulation problems* – Many physiotherapeutic interventions are used to increase circulation to aid healing. If the circulatory system could not withstand an increase in the area to be treated, then caution should be taken when choosing the treatment method.

*Myopathies* – Such as myasthenia gravis and exertional rhabdomyolysis need to be recognised and diagnosed by a veterinary surgeon. Physiotherapy is not indicated or appropriate in these cases. If a patient is referred to physiotherapy and is suspected to have a myopathy, prompt referral back to the veterinary surgeon is required.

*Behaviour* – Aggressive animals need to be treated with extreme caution. The aggression can be a sign of pain, which will reduce as the treatment progresses, however the therapist must be careful to protect him/herself at all times by the use of a muzzle and the owner handling the patient where possible. Some animals can become aggressive when placed in a clinical situation and it is important to recognise this and work with the owner to minimise the stress levels of the animal and work on desensitising the animal to the situation.

It is important to state that when working in rehabilitation, a close relationship between the referring veterinary surgeon, physiotherapist and owner is required. If a case is not responding to physiotherapy, further investigations may be required. For example, a case referred to physiotherapy for stifle pain that is not responding to treatment could be referred lumbar pain from spondylosis of that region.
This chapter aims to give an overview of the structure and function of the musculoskeletal system. Bony landmarks, palpable on the live dog, will be highlighted as they are important for clinical examination and form the reference points for measuring range of motion. In most instances, the location of muscle groups will be described. Where specific pathological conditions occur in an individual muscle, tendon or ligament, these structures will be described in more detail. For an in-depth guide to anatomy, the readers are referred to more detailed texts (see further reading, Appendix 3).

The structure of a tissue is a result of the forces (function) placed upon it. This is sometimes called adaptive remodelling (Wolff's law.) Originally, this was applied only to bone and can be demonstrated by placing a foreleg in a cast so that the cast takes the weight previously taken by the bone. The bone demineralises and loses some of its strength. This change is reversible by removing the cast and allowing weight-bearing forces to act upon the bone. Wolff’s law is equally true for other structures within the musculoskeletal system. The musculoskeletal system is a dynamic system that is designed to move, and its structure depends on that movement. Movement may also influence nutrition, for example, cartilage. Immobilisation can have devastating effects on the musculoskeletal system, but may be necessary to protect sites of injury and surgical repair. Physiotherapy can help reduce the impact of periods of immobilisation or cage rest by maintaining calculated forces and stresses on the musculoskeletal system without compromising the surgical repair or site of injury.

**Collagen**

Collagen is the main building block in the body and is found in a host of different tissues. There are many types of collagen, but for the purpose of this textbook, we focus on the three main types, which are described as follows:

Type 1 collagen is found in connective tissue and is very strong. It consists of long triple-helix proteins interwoven with adjoining strands that intertwine to form strong rope-like structures with high tensile strength. It is found in tendons, ligaments and bone.

Type 2 collagen consists of shorter chains of proteins than type 1 collagen. The strands are arranged more randomly and in different directions. They are found within the
extracellular matrix of articular cartilage. Type 2 collagen is also a main component of fibrocartilage that is found in the menisci.

Type 3 collagen is found in blood vessels, skin and intestines. It also has a triple-helix structure but with much shorter chains. Type 3 collagen is produced by fibroblasts in response to injury and forms part of the initial scar. Gradually as scar tissue is reorganised, the type 3 collagen is converted to type 1 collagen.

**Elastin**

Elastin is another protein found in many connective tissues, including tendons, ligaments, joint capsule and cartilage. Elastin allows these tissues to undergo reversible deformity. The amount of elastin in a tissue varies greatly depending upon the degree of elasticity of that tissue. For instance, joint capsules that undergo repeated cycles of elongation and recoil contain significantly more elastin than bone where its presence is restricted mainly to the blood vessels. Elastin is produced during the repair and remodelling phases of tissue healing.

**Bone**

Bone consists of a type 1 collagen framework with an extracellular matrix of calcium salts (calcium hydroxylapatite and others). In cortical bone, as in the shaft of a long bone, the framework is a series of overlapping Haversian units. These have a central blood vessel with concentrically arranged cylinders of bone matrix. Embedded in the bone matrix are the osteocytes that are responsible for the production of the matrix.

![Figure 2.1](image.png)  
**Figure 2.1** Schematic representation of the structure of a long bone showing the Haversian systems, cancellous bone, periosteum, endosteum and bone marrow.
Trabecular or cancellous bone is found at the ends of long bones (metaphysis) and on the endosteal surface of long bones, immediately below the endosteum. Trabecular bone is composed of sheets of bone (trabeculae) surrounding islands of fat and haemopoietic cells. Trabecular bone has a rich blood supply and is populated by large numbers of osteoblasts. The bone is covered by a periosteal surface externally and an endosteal surface in the medullary cavity. The periosteum and endosteum are also rich in blood vessels and osteoblasts. Osteoblasts are responsible for the production of new bone. They lay down the extracellular matrix (ECM) and eventually become embedded in the ECM and mature into osteocytes (Figure 2.1).

Bone is constantly undergoing remodelling and is a balance between the activity of osteoblasts, which lay down new bone and the resorption of the existing bone by osteoclasts. This remodelling activity is controlled by the osteophytes that respond to alteration in the mechanical forces applied to the Haversian systems. The osteocytes then trigger increased osteoblast or osteoclast activity depending on the mechanical forces.

**Cartilage**

There are three basic types of cartilage.

1 *Hyaline or articular cartilage*. This covers the opposing surfaces of bones making up a synovial joint. Hyaline cartilage consists of an extracellular matrix of proteoglycan with type 2 collagen strands arranged in different directions. It also has some elastin strands. It is sparsely populated by chondrocytes that are responsible for the production of the extracellular matrix. Cartilage is avascular and aneural. Articular cartilage undergoes considerable reversible deforming forces during joint movement. When cartilage is compressed, the cellular matrix loses water and waste products. As it is decompressed, the water and dissolved nutrients return. This is an important mechanism for the nutrition of the chondrocytes. Replenishment of extracellular matrix does occur, but if sufficient articular cartilage damage occurs, repair is with fibrocartilage.

2 *Fibrocartilage*. Fibrocartilage consists of an extracellular matrix with type 1 collagen and elastin. The chondrocytes are embedded in the matrix. Fibrocartilage is a tough flexible tissue, and is found in the menisci, annulus fibrosis of the discs and in entheses (see page 10).

3 *Elastic cartilage* is very flexible due to its high elastin content. Examples would include the epiglottis, larynx and ears.

**Tendons, ligaments and entheses**

Both tendons and ligaments are made of dense connective tissue mostly composed of type 1 collagen. They have few cells (fibroblasts) and poor blood supply, and hence the healing process is slow in these tissues (Figure 2.2).

In *tendons*, the fibres are arranged in parallel bundles. Tendons also run in sheaths that facilitate free movement through surrounding tissues.

In *ligaments*, the fibres are less parallel and less closely woven to allow twisting. Ligaments also contain more elastin, therefore allowing for more stretch.
Entheses
Entheses are specialised structures at the attachment sites of muscles, tendons and ligaments. Entheses have evolved to dissipate the tremendous stresses that occur at the bone/muscle or bone/tendon junction. There are two types of entheses. Fibrous entheses occur where muscle attaches directly to bone. Collagen fibres (Sharpey’s fibres) run from the muscle, blend into the periosteum and attach to the cortical bone. Fibrocartilage entheses contain a zone of fibrocartilage at the site of the tendon or ligament attachment. These serve as a transition area between the parallel fibres of the tendon or ligament and the bone matrix.

Function of tendons and ligaments
Tendons
Tendon connects muscle to bone and acts to transfer the power generated by the muscle to the lever action of the bone. Tendons have twice the tensile strength of muscle, and hence often the muscle tears at the musculo-tendon junction.

Ligaments
Ligaments stabilise joints. They connect bone to bone. They guide joint movement. They prevent excess movement of the joint.

Injury of tendons and ligaments
Injury can be a sudden snap due to excessive forces, such as an acute traumatic cranial cruciate rupture. However, more commonly, injuries to tendons and ligaments are repetitive strain injuries. Repetitive overloading of tendons and ligaments causes microfractures and disruption within the collagen bundles.

Factors affecting tendon and ligament injury

Ageing. As animals age, the amount of collagen present in their body decreases.
Immobilisation. If the tendons and ligaments are not used and stressed within normal limits, they become loose and unable to carry out their full function.
Repetitive strain such as contact dismounts in agility dogs can lead to tendon and ligament injury.

Physical training leads to an increase in strength of tendons, thereby reducing the risk of injury.

**Joints**

Joints are divided into three types as follows:

1. Fibrous joints (synarthroses). These have little or no motion. An example would be the sutures in the bones of the skull and tooth sockets.

2. Cartilaginous joints. These have limited movement that permits compression and stretching. Examples would be:
   - (a) Hyaline cartilage (synchondrosis) such as costochondral junctions and epiphyseal growth plates in the long bones of growing animals.
   - (b) Fibrocartilage (amphiarthrosis) such as mandibular symphysis.

3. Synovial joints (diarthroses). These allow for the greatest range of motion. They consist of two or more bone endings covered with hyaline (articular) cartilage.

   Synovial joints have a joint cavity, joint capsule, synovial membrane and synovial fluid. In addition, some joints may have intra-articular ligaments, tendons, menisci and fat pads. Other ligaments and tendons may be extra-articular.

   The synovial membrane is very vascular, and blends with the periosteum. It is thrown into numerous villus projections. The function of the synovial membrane is phagocytosis and synovial fluid production.

   Synovial fluid is a filtrate of blood to which mucoproteins, such as hyaluronic acid, have been added by the cells of the synovial membrane. The function of the synovial fluid is to lubricate the joint to help reduce wear and tear and to provide nutrition for the chondrocytes in the articular cartilage.

**Intervertebral discs**

The intervertebral discs lie between the bodies of neighbouring vertebrae with the exception of the atlas and axis. The disc is composed of a tough outer fibrous layer, the annulus fibrosis, which is comprised of fibrocartilage and a jelly-like centre, the nucleus pulposus.

**Muscle**

**Types of muscle**

There are three types of muscle found within the body as follows:

- Smooth muscle found in the gut and blood vessels.
- Heart muscle.
- Striated muscles. These are the muscle of conscious movement. The scope of this textbook is restricted to striated muscle.
How muscle works

The most popular theory as to how muscle works is the Sliding Filament Theory (Figure 2.3).

The myosin molecules have heads. When ATP releases energy, the heads snap up to attach on to the actin. The actin is moved inwards moving the Z-lines towards each other and it results in a shortening of the sarcomere, myofibril and muscle. When the energy has been used, the heads snap back down causing the Z-lines and the actin molecules to return to their original position. Alternating layer of actin and myosin are held together by cross-bridges.

Motor unit

A motor unit consists of a single nerve fibre (neuron) and all the muscle fibres innervated by it. All fibres respond together. The number of fibres per neuron determines the degree of control. For example, in hands, there are only few muscle fibres per neuron. This gives very fine control and precise movement of the digits. The degree of control required in a large muscle group like the quadriceps is much less therefore each neuron innervates a large number of muscle fibres (Figure 2.4).

Types of muscle fibres

Muscle fibres are divided into two groups: Type 1 and Type 2

Type 1 Fibres. These are sometimes known as slow-twitch muscle fibres. Slow twitch refers to how often the neurons innervating the muscle fire to keep the muscle working. These muscles obtain their energy by aerobic respiration and are muscle groups that do prolonged/low-intensity work. These are the muscles of posture.
Figure 2.4  Motor unit consists of a single neuron and all the muscle fibres innervated by it. Akers and Denbow Anatomy and Physiology of Domestic Animals. Figure 7.16. Reproduced with permission of Wiley.

and core stability. This work is primarily seen in the postural muscle. They would include the paraspinal groups, and the internal and external abdominal obliques. Type I fibres are also found in the quadriceps and triceps along with type II fibres.

Type II Fibres. These are often referred to as fast-twitch muscles as the innervating neurons fire more often than their slow-twitch counterparts.

Type II fibres are further divided into Type IIa and Type IIb fibres. Type IIa are the long-distance muscles that are used for stamina and endurance, and use aerobic respiration. Type IIb are the speed muscles used in short bursts, and use anaerobic respiration.

Often type IIb muscles are plump round muscles such as the acromion head of deltoid. By contrast, the spinous head of deltoid is more strap-like, typical of a type IIa muscle.

Breed differences and training
Breeds such as huskies are bred for endurance and will have more type IIa fibres. Border collies will have a mixture of type IIa and type IIb fibres. Breeds such as whippets will have more type IIb fibres.

Training regimes can affect the predominance of one or other type of fibre. For instance, long-distance training with the dog running for great lengths of time at a steady pace will promote type IIa fibres. Interval training, where the dog does a short sprint for 1 minute followed by a walk for 2 minutes repeated over the course of 20 minutes will promote type IIb fibres.

Immobilisation
Immobilisation or prolonged inactivity, for example, cage rest, leads to atrophy of type I fibres first, followed by disuse atrophy of type II fibres. Where there has been loss of type I fibres, core stability will be significantly affected. If there is disuse atrophy of
Chapter 2

muscle that would normally support a joint, then often there will be recruitment of neighbouring muscle groups to try to stabilise the joint and these may not be postural muscles. These groups are then not available for locomotion and often become chronically tight or tied down to adjoining muscle groups and fascia. An example of this would be deep and superficial pectorals becoming tied down in long-standing shoulder problems where the supra- and infraspinatii muscles and subscapularis muscle have atrophied and no longer able to support the joint in normal posture.

Factors affecting muscle mass

*Age.* Muscle mass decreases as part of the ageing process.

*Diet.* Poor diet/starvation will result in reduced muscle mass.

*Hereditary.* Several hereditary conditions are recognised that result in reduced muscle mass, for example, type 2 muscle fibre deficiency in Labrador Retrievers.

*Disuse atrophy.* Wolff’s law again. If not used, a muscle will reduce in bulk. Conversely training can increase muscle bulk.

*Wallerian degeneration.* A lower motor neuron lesion (LMN) will significantly reduce muscle mass very quickly.

*Endocrine diseases.* Diseases such as Cushing’s disease, diabetes mellitus and hypothyroidism will also result in reduced muscle mass and muscle tone.

Types of contraction

**Isometric**

An isometric contraction is a muscle contraction but with no joint movement. An example of this would be a dog playing with a tug toy. This is something to bear in mind when drawing up a home exercise programme where joint movement may be painful or produce unwanted wear on a joint. In this situation, increasing muscle bulk may be desirable but not at the expense of further joint damage.

**Isotonic**

With an isotonic contraction, there is a joint movement when the muscle contracts. There are two types of isotonic contraction: Concentric and Eccentric.

With a *Concentric* contraction, there is a shortening of muscle, for example, picking up shopping and bending the elbow.

With an *Eccentric* contraction, there is lengthening of muscle fibres, for example, lowering the shopping basket by extending the elbow.

Why is this important?

In general, eccentric contractions build muscles quicker. An eccentric contraction followed by a concentric contraction is called plyometrics and is a very good way of building muscle in the *canine athlete* (see Chapter 8).

Contraction versus contracture

A contraction is a normal shortening of a muscle. It is under voluntary or involuntary control and is reversible.

A contracture is a fixed shortening of muscle and is pathological.